FINAL REPORT
CALFED SCIENCE PROGRAM PROJECT NUMBER: Grant Agreement #1037
PROJECT TERM: 1 April 2007-30 June 2010 (extension to June 2011)
PROJECT TITLE: Climate change impacts to San Francisco Bay-Delta Wetlands: Links to pelagic food webs and predictive responses based on landscape modeling.

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Funding Source: CALFED Science Program

Project Location: San Pablo Bay wetlands to Delta wetlands

PROJECT RESULTS

Executive Summary

This project investigated aspects of tidal wetland ecology that might be affected by climate change. A central question or climate change impacts revolved around whether pelagic food webs might have links to tidal wetlands. Subsequent issues were how tidal wetlands in the estuary might respond to major predictions for the SF Bay-Delta system, specifically, increases in salinity and increases in the rate of sea level rise (inundation for tidal wetlands). We first found strong links from wetlands to fish food webs, principally through the detrital food webs of the wetlands. We also found that wetlands are currently keeping up with the increasing rate of sea level rise via both sedimentation and accretion of organic matter. Other aspects of wetlands indicate strong sensitivity to salinity, especially seed germination and plant productivity. These results and others are presented below, arranged by "Task" as in the original contract.

TASK 1: Project Management

Project management over the several years involved organizing meetings, purchasing equipment and supplies, replacing Co-PIs, research technicians, and research assistants. Other tasks included maintaining permits, boats, and dealing with regulations. The principal task is, of course, paperwork. A major issue was the freezing of CalFed funds; this was an incredibly disruptive process, trying to keep from losing employees and trying to figure out how to recover from losing multiple long-term experiments. In reality, we never fully recovered from that.

Other highlights:

Meetings were held with Co-PIs, students, and laboratory technicians to plan field sampling, develop modeling plants and coordinate modeling with Diana Stralberg (formerly at PRBO Conservation Science). This also involved coordination with other individuals and groups, such as, Steve Crooks from PWA ESA. The modeling coordination with Diana Stralberg resulted in a publication (see Stralberg, D., M. Brennan, J.C. Callaway, J.K. Wood, L. M. Schile, D. Jonsomjit, M. Kelly, V.T. Parker and S. Crooks. 2011. Evaluating tidal marsh sustainability in the face of sea-level rise: a hybrid modeling approach applied to San Francisco Bay. *PLoS On*e 6(11): e27388. doi:10.1371/journal.pone.0027388).

Ellen Herbert, the primary research technician, left the project at the end of July 2010 to begin a graduate program at Indiana University; Jessica van den Berg and Evyan Borgnis replaced her as research technicians (both had previously been employed as hourly technicians of the project). Jessica worked full-time while Evyan was part-time. Meetings with Jessica and Evyan were held to review progress and outline the remainder of the work to complete.

Dr. Vance Vredenburg of SF State agreed to assume Dr. Drew Talley's responsibilities as Co-PI and advisor for Task 2 (Food Web Analysis). Dr. Talley assumed a full-time position at University of San Diego.

TASK 2: Food Web analyses using stable isotopes

Many tidal wetlands provide critical habitat and trophic support for a variety of fish species in many other estuaries. Through this task we sought to increase our understanding of the connections between tidal wetland primary productivity and pelagic fish species in the SF Bay-Delta, using naturally occurring ratios of carbon, nitrogen and sulfur stable isotopes.

We have finished preparing samples and having them analyzed. We continue in the process of analyzing the results from this component of the project. Our original approach was to use the ISOSOURCE/SOURCE model; however, this has been replaced by other models that use the statistical software R. We are making progress in learning how to use the new program and incorporate the new modeling approach. Meanwhile, we have over 400 stable isotope samples completed for N, C, and S. We have initiated the first manuscript from this task and are will be incorporating final data analyses.

Our specific objectives within this task were 1) to determine if there is a connection between tidal wetland productivity and the pelagic food web, in particular for resident fish species and 2) to evaluate how this connection varies across the salinity gradient of the Estuary. As tidal wetland restoration proceeds in different portions of the estuary, we expect that the additional productivity will cascade into the pelagic system through the additional productivity and food web linkages.

Some highlights we have found so far (Fig. 1, 2):

- Salt and freshwater wetlands show distinct differences in $\delta^{13}C$ signatures indicating differences in primary food sources.
- Preliminary data suggest $^{15}N/^{13}C$ signatures combined with gut contents analysis can be used to distinguish differences in sources of primary productivity between marshes.
- Macrophyte productivity from tidal wetlands enters the food web primarily through the invertebrate detrital feeders.

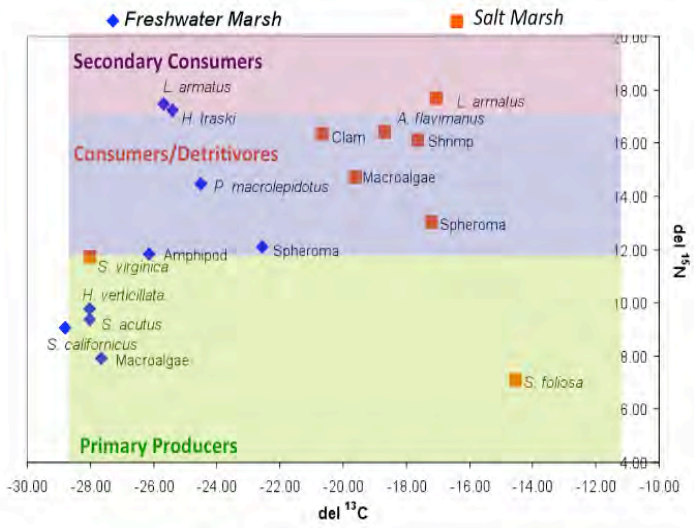

Figure 1. Stable isotope values indicate significant differences between salt and freshwater marshes in terms of the sources of productivity. Subsequent movement through the food web appears to be through invertebrate detrital feeders; then fish.

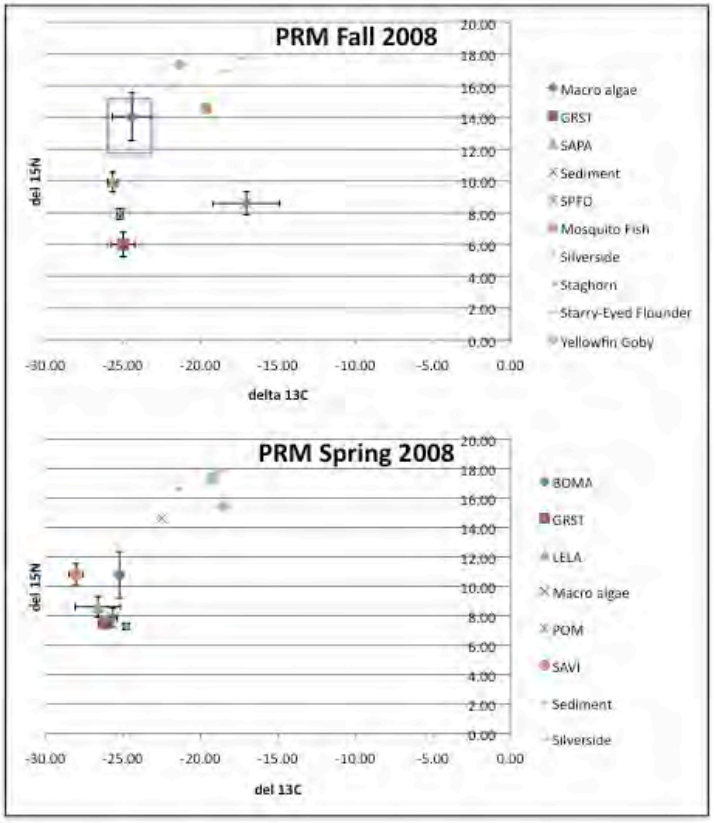

Figure 2. Variation in stable isotope values among seasons. Data are shown for Petaluma River Marsh. In general values remain fairly constant, but individual sources do vary. Similar data are found for China Camp, Coons Island, Rush Ranch, Browns Island and Sand Mound Slough.

TASK 3: Tidal Wetland analyses

We had a number of objectives for this task in our original proposal, and we added additional objectives as our research developed over the course of the project. In particular, we sought to measure: 1) wetland vascular plant productivity over a single year; 2) seasonal and spatial variation in soil salinity along transects within all six wetlands; 3) aboveground decomposition rates at a subset of three wetlands (decomposition is a key link between wetland productivity and the benthic and pelagic food webs); and 4) sediment dynamics and subsequent elevation change (using feldspar and SET measurements to determine changes through time). Finally, a Master's student as SF State conducted a seed bank study at Browns Island, while Lisa Schile, a Ph.D. student at UC Berkeley, conducted a transplant study at Rush Ranch and Browns Island to evaluate the effects of increased rates of inundation and competition on plant productivity in brackish marshes in the Estuary.

Highlights from these studies (Fig. 3-7; Tables 1-2):

- Productivity in freshwater wetlands is almost 10x higher than in salt marshes.
- In rainless summer months that are typical of Mediterranean climates, soil salinity increases from near channel to high marsh, with the steepest gradient in salt marsh sites (China Camp and Petaluma River)(n=5 transects per marsh).
- Litter turnover rates were highest in freshwater marshes.
- Decomposition of the salt marsh dominant *Salicornia pacifica* was faster initially (for only the first 3-6 months) compared to brackish and freshwater dominants (*Schoenoplectus americanus* and *Schoenoplectus californicus*).
- After nearly a year, decomposition rates were relatively rapid at all sites, with less than 30% of material remaining, and freshwater marshes had the least litter remaining.
- Germination of seeds within the seed bank was reduced substantially at higher salinity (3 ppt or 10 ppt).
- In the seed bank experiments, soil seed banks were collected along transects from channel edges (freshwater) to 150 m inland (mesosaline). Salinity was added to flats in greenhouses after well-mixed samples were split and randomly assigned to treatments.
- Seed bank composition was not strongly related to position on the transect, nor closely related to above-ground vegetation, indicating seeds are well dispersed within individual wetlands.
- *Schoenoplectus americanus* is more sensitive to increased rates of tidal inundation than *Schoenoplectus acutus* (based on transplant experiment results from Lisa Schile).

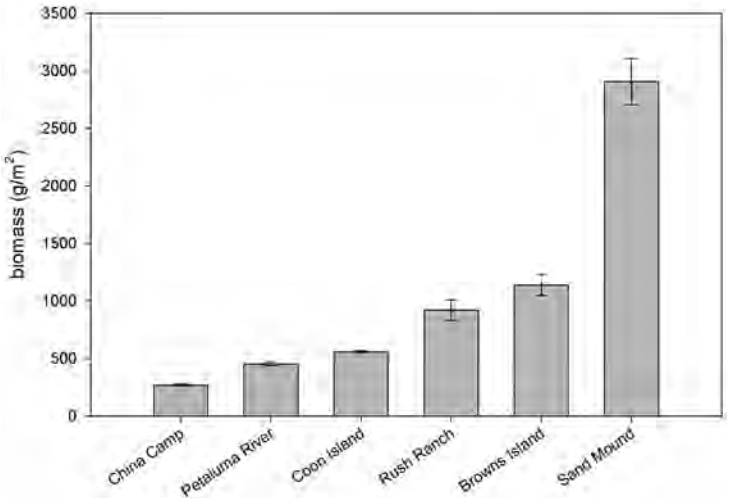

Figure 3: Productivity shifts along the salinity gradient of the SF Bay- Delta Estuary (as measured by end-of-year standing biomass).

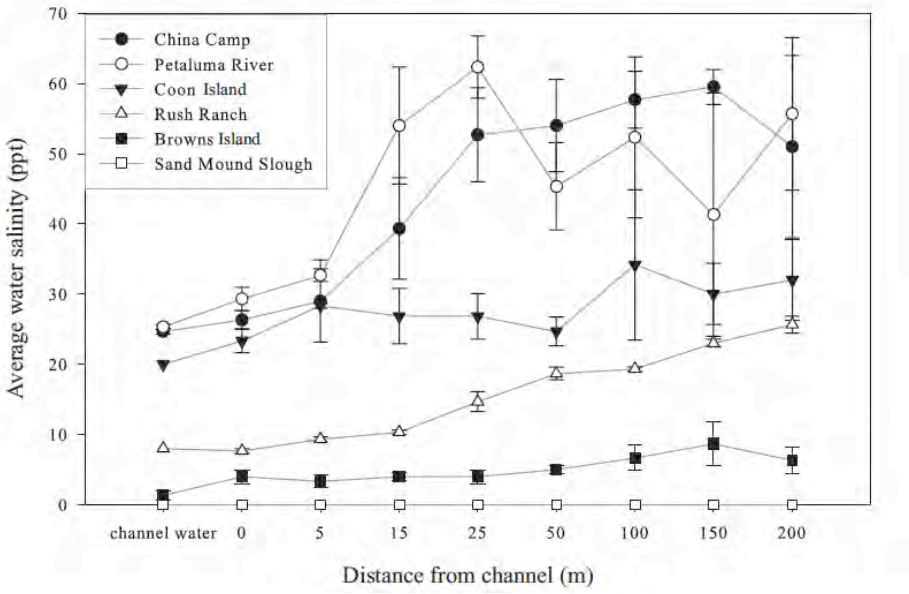

Figure 4. Variation in salinity (ppt) across the estuary, and variation from tidal channel edges to the interior of a wetland. Values were collected during fall 2008. China Camp and Petaluma River Marsh are salt marshes, Coon Island and Rush Ranch are brackish tidal wetlands, Browns Island is an oligohaline wetland, and Sand Mound Slough contains freshwater tidal wetlands.

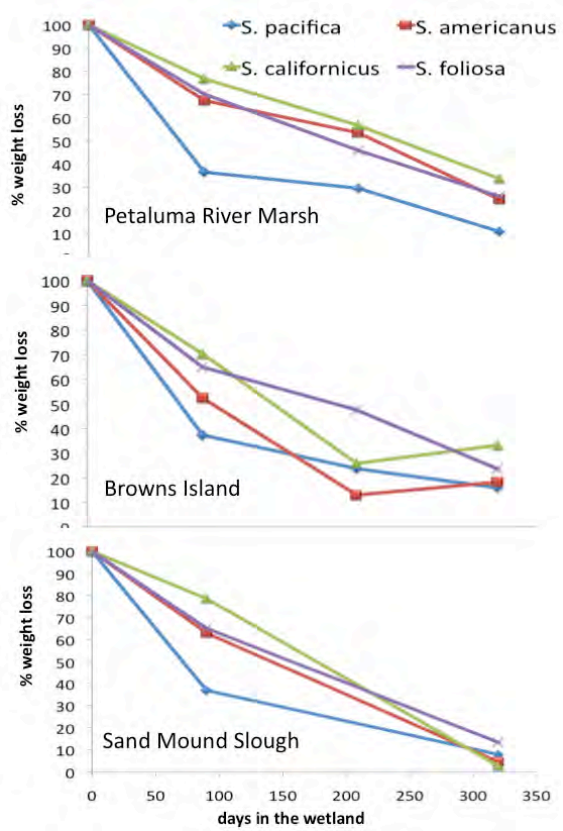

Figure 5. Decomposition across the Estuary using four different species at each site (Petaluma Marsh –saline; Browns Island-freshwater to low salinity; Sand Mound Slough- freshwater).

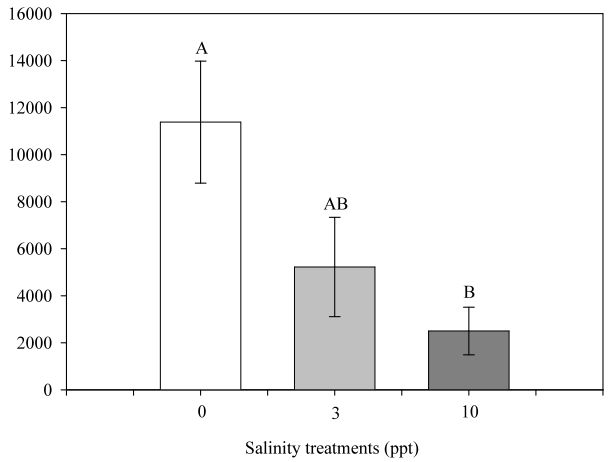

Figure 6. Total number of germination +/- SE for control and salinity treatments (n=25). Actual numbers were tabulated then converted to per square meter. Total germination for each treatment was: 11,383 for 0 ppt, 5,223 for 3 ppt, and 2,502 for 10 ppt.

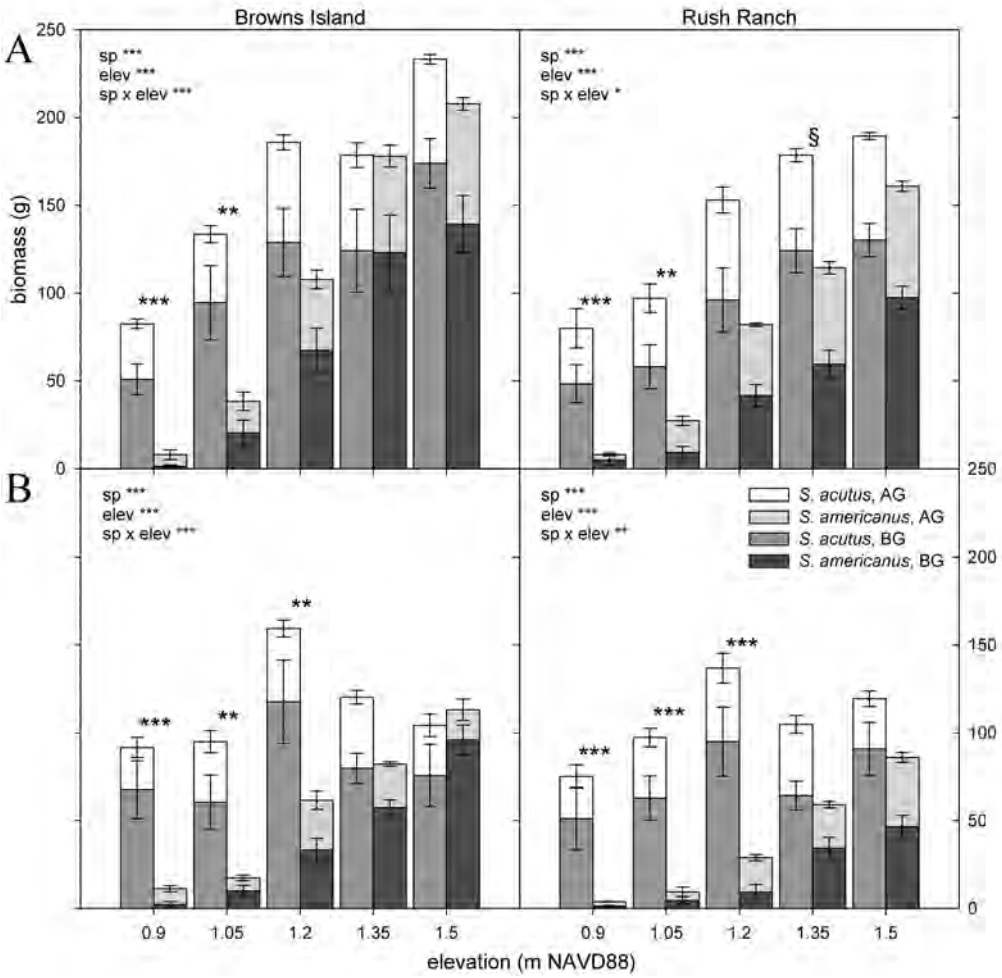

Figure 7. Above-ground (AG), below-ground (BG), and total biomass of *S. acutus* and *S. americanus* grown a) alone and b) together at different elevations at Browns Island and Rush Ranch (N = 7; error bars = ±1 SE; ANOVA summary statistics of are upper corner; *** = $P < 0.0001$, ** = $P < 0.001$, and * = $P < 0.05$; § = significant differences between species for BG biomass only at $P < 0.05$).

Table 1. Similarity analysis of seed banks for each distance (Jaccard/Sorenson)

	0.5 meters	5.0 meters	20 meters	75 meters	150 meters
0.5 meters	1/1	0.52/0.68	0.46/0.63	0.43/0.6	0.43/0.6
5 meters	0.52/0.68	1/1	0.57/0.73	0.52/0.68	0.46/0.63
20 meters	0.46/0.63	0.57/0.73	1/1	0.67/0.8	0.68/0.81
75 meters	0.43/0.6	0.52/0.68	0.67/0.8	1/1	0.61/0.76
150 meters	0.43/0.6	0.68/0.63	0.68/0.8	0.61/0.76	1/1

Table 2. Similarity analysis of vegetation means vs. seed bank means for each distance.

	Jaccard	Sorenson	Czekanowski's
0.5 meters	0.2963	0.0302	0.2052
5 meters	0.28	0.0302	0.2625
20 meters	0.2381	0.0289	0.2617
75 meters	0.28	0.0302	0.1476
150 meters	0.1364	0.014	0.1332

TASK 4: Spatial Modeling

Wetlands across the estuary are likely to have differential sensitivity to climate change, as well as differential links to pelagic food webs. In order to understand these spatial dynamics, we've developed spatial models that evaluate the sensitivity of tidal wetlands to a range of potential climate change scenarios (including differential rates of sea-level rise and sediment availability). As noted above, results from our collaboration with Diana Stralberg were published in *PLoS One*. This model used a direct feedback between marsh elevation and mineral sediment inputs to mechanistically model sediment deposition. Organic sediment accumulation was modeled as a constant within regions. Currently, Lisa Schile is working on improvements to this model, incorporating feedbacks between marsh elevation and plant productivity that more realistically simulate organic matter accumulation. This model (the Marsh Equilibrium Model or MEM 3) was developed by Jim Morris at the University of South Carolina, and is available at: http://jellyfish.geol.sc.edu/model/marsh/mem.asp). Model runs have been completed for four marsh locations (China Camp, Coon Island, Rush Ranch, and Browns Island), using multiple combinations of sea-level rise and suspended sediment concentrations, and these results are being projected across marsh elevations at each site.

Highlights:

- We worked with Diana Stralberg at PRBO and others to develop the modeling of marsh elevations under climate change using a feedback on mineral inputs and constant accumulation rates for organic matter accumulation.

- Results from this model were published in *PLoS One* and indicate that tidal marshes would be relatively stable at low levels of sea-level rise, but highly vulnerable at higher rates of sea-level rise, especially at lower concentrations of suspended sediment.

- An interactive version of this model is available at: http://www.prbo.org/sfbayslr

Preliminary MEM results indicate that marshes can keep pace with predicted sea-level rise up to 165 cm over 100 years given that suspended sediment concentrations remain consistent with current estimates and upland habitat is available for marsh migration. As suspended sediment concentrations decrease, more marsh habitat shifts from mid marsh to low marsh vegetation and begins to transition to mudflat at lower, formerly vegetated, elevations. Low salinity brackish marshes appear to be more sensitive to increases in sea-level rise than higher salinity marshes.

DELIVERABLES:

Publications:

In Preparation and Review:

In preparation:

One to two articles on food web analyses using the stable isotope results (in preparation)
One article on salinity trends in the SF Bay Estuary wetlands (in preparation)
One article on plant productivity and decomposition rates (in preparation)
One article on seed banks (in preparation, based on SFSU MS thesis)
One article on the effect of increased inundation rates on plant growth from field transplant study (in preparation)
One article on inundation-salinity interactions based on another just completed SFSU MS thesis
One article on wetland sedimentation dynamics (in preparation, including data from other sites in the estuary)
One article on updated spatial modeling efforts focusing on organic matter accumulation (in preparation)
Others as we finish data analysis.

In review:

Vasey, M.C., V.T. Parker, L.M. Schile, J.C. Callaway & E.R. Herbert. *In review*. Vegetation of the tidal wetlands in SF Bay-Delta. San Francisco Estuary and Watershed Science.

In Press or Published:

2012

Callaway, J.C. & V.T. Parker. 2012. Current issues in tidal marsh restoration. In: Tidal Salt Marshes of the San Francisco Bay Estuary: ecology, restoration, preservation, pp. 253-262. A. Palaima (ed.) University of California Press, Berkeley.

Callaway, J.C., A.B. Borde, H.L. Diefenderfer, V.T. Parker, J.M. Rybczyk, & R.M. Thom. 2012. Pacific Coast tidal wetlands. Pages 103-116 *in* D.P. Batzer and A.H. Baldwin, editors. Wetland habitats of North America: Ecology and conservation concerns. University of California Press, Berkeley, CA.

Parker, V.T., J.C. Callaway, L.M. Schile, M.C. Vasey & E. Herbert. 2012a. Tidal marshes in the context of climate change. In: Tidal Salt Marshes of the San Francisco Bay Estuary: ecology, restoration, preservation, pp. 87-94. A. Palaima (ed.) University of California Press, Berkeley.

Parker, V.T., J.C. Callaway, L.M. Schile, M.C. Vasey & E. Herbert. 2012b. Tidal vegetation: spatial and temporal dynamics. In: Tidal Salt Marshes of the San Francisco Bay Estuary: ecology, restoration, preservation, pp. 97-111. A. Palaima (ed.) University of California Press, Berkeley.

2011

Callaway, J.C., V.T. Parker, L.M. Schile, M.C. Vasey & E.R. Herbert. 2011a. Tidal wetland restoration in the San Francisco Bay: History and current issues. In: Ferner, M.C.,

editor. A profile of the San Francisco Bay National Estuarine Research Reserve, pp. 42-57. San Francisco Bay National Estuarine Research Reserve. San Francisco, CA. 345 p. plus appendix.

Callaway, J.C., V.T. Parker, M.C. Vasey, L.M. Schile, and E.R. Herbert. 2011b. Tidal wetland restoration in San Francisco Bay: History and current issues. San Francisco Estuary and Watershed Science 9(3) http://escholarship.org/uc/item/5dd3n9x3

Diggory, Z.E. and V.T. Parker. 2011. Seed supply and revegetation dynamics at restored tidal marshes, Napa River, CA. Restoration Ecology 19, No. 101: 121–130.

Parker, V.T., J.C. Callaway, L.M. Schile, M.C. Vasey, and E.R. Herbert. 2011a. Climate change and San Francisco Bay-Delta tidal wetlands. San Francisco Estuary and Watershed Science 9(3). http://www.escholarship.org/uc/item/8j20685w

Parker, V.T., J.C. Callaway, L.M. Schile, M.C. Vasey & E.R. Herbert. 2011b. Climate change and San Francisco Bay-Delta tidal wetlands. In: Ferner, M.C., editor. A profile of the San Francisco Bay National Estuarine Research Reserve, pp. 171-188. San Francisco Bay National Estuarine Research Reserve. San Francisco, CA. 345 p. plus appendix.

Parker, V.T., E.R. Herbert, J.C. Callaway, L.M. Schile, and M.C. Vasey. 2011c. Climate change impacts on San Francisco Bay-Delta tidal wetlands. In: Willoughby, J.W., B.K. Orr, K.A. Schierenbeck, and N.J. Jensen (eds.) Strategies and Solutions, pp. 239-244. CNPS, Sacramento, CA

Parker, V.T., L.M. Schile, M.C. Vasey and J.C. Callaway. 2011d. Do gradient-directed transects work at small scales: A test using tidal wetland vegetation sampling design. Ecosphere 2: art99. [doi:10.1890/ES11-00151.1]

Schile L.M., Callaway J.C., Parker V.T., Vasey M.C. 2011. Salinity and inundation influence productivity of the halophytic plant *Sarcocornia pacifica*. Wetlands 31(6): 1165-1174.

Stralberg, D., M. Brennan, J.C. Callaway, J.K. Wood, L.M. Schile, D. Jonsomjit, M. Kelly, V.T. Parker and S. Crooks. 2011. Evaluating tidal marsh sustainability in the face of sea-level rise: a hybrid modeling approach applied to San Francisco Bay. PLoS One 6(11): e27388. doi:10.1371/journal.pone.0027388

Tuxen, K, D. Stralberg, S. Siegel, L. Schile, V.T. Parker, M. Vasey, J.C. Callaway, and M. Kelly. 2011. Tidal marsh vegetation mapping using high-resolution aerial photography and a hybrid pixel-based classification approach. Wetlands Ecology and Management 19: 141-157. (mostly based on previous IRWM CalFed project)

Vasey, M.C., V.T. Parker, L.M. Schile, J.C. Callaway & E.R. Herbert. 2011. Tidal wetland vegetation in the San Francisco Bay-Delta Estuary. In: Ferner, M.C., editor. A profile of the San Francisco Bay National Estuarine Research Reserve, pp. 58-78. San Francisco Bay National Estuarine Research Reserve. San Francisco, CA. 345 p. plus appendix.

Earlier publications:

Callaway, J.C., V. T. Parker, M. C. Vasey, L. M. Schile. 2007. Emerging issues for the restoration of tidal marsh ecosystems in the context of predicted climate change. Madroño 54 (3): 234–248.

Leck, M.A., A. Baldwin, V.T. Parker, L.M. Schile, and D. Whigham. 2009. Plant communities of tidal freshwater wetlands of the continental USA and Canada, pp. 41-58. *In*: A. Barendregt, D.F. Whigham and A.H. Baldwin. (eds.) *Tidal Freshwater Wetlands*. Backhuys Publ; Leiden, The Netherlands. (mostly based on previous IRWM CalFed work and early work on this project)

Presentations:

2011

Callaway, JC. Implications of shifting sediments and salinities for San Francisco Bay tidal wetlands. 2011 Society of Wetland Science Conference. Prague, Czech Republic.

Callaway, JC, and VT Parker. Suisun Marsh in the 21st Century: A landscape of change & opportunity. Symposium; Center for Aquatic Biology and Aquaculture; sponsored by Delta Science Program and Center for Watershed Sciences. – *Panelist* for afternoon session on Suisun Marsh vegetation

Julian Wood, Sam Veloz, Leo Salas, Nadav Nur, Lisa Schile, John Callaway, V.T. Parker, Grant Ballard. Spatial Climate Change Scenarios for San Francisco Bay: Tidal Marsh Plant and Bird Communities. May 2011; Headwaters to Ocean Conference, San Diego; sponsored by California Shore and Beach Preservation Association, California Coastal Coalition, Southern California Wetlands Recovery Project, Society of Wetland Scientists - Western Chapter and the Tijuana River National Estuarine Research Reserve Coastal Training Program.

Parker, V.T. September 2011: Modeling for sustainability of tidal marshes: workshop. Workshop participant and panelist. 2 presentations, 1 poster; Oakland, CA.

Parker, V.T., J.C. Callaway, E. Borgnis, E. Herbert, J. Vandenberg, V.T. Vredenburg. Tidal wetlands link to pelagic food webs in the SF Bay-Delta Estuary. September 2011: State of the Estuary Meeting, 2011. Oakland, CA.

Bishop, S. and V.T. Parker. Determining climate change effects on two dominant tidal marsh plant species. September 2011: State of the Estuary Meeting, 2011. Oakland, CA.

Schile, L. M., J.C. Callaway, and M. Kelly. Effects of simulated sea-level rise on the growth of two tidal wetland plant species. September 2011: State of the Estuary Meeting, 2011. Oakland, CA. (*Winner of Best Student Poster award*).

2010

Herbert, EH, VT Parker, JC Callaway, EL Borgnis, and LM Schile. Vegetation biomass dynamics across an estuarine salinity gradient: organic matter contributions of tidal wetland accretion. *Poster*. 2010 Society of Wetland Science Conference. Salt Lake City, UT.

Borgnis E.L., Callaway J.C., Parker V.T., Herbert, E.R., Schile L.M., Turner R.E., Milan C.S., Drexler J.Z. Sediment dynamics and elevation changes in tidal wetlands of the San Francisco Bay Estuary in face of a rising tide. 2010 Society of Wetland Science Conference. Salt Lake City, UT.

Schile, LM, MC Vasey, VT Parker, JC Callaway, ER Herbert, and NM Kelly. Tidal wetland vegetation diversity gradients across and within sites in the San Francisco Bay Estuary. *Poster*. 2010 CalFed Science Conference. Sacramento, CA.

Parker, VT. The once and future wetlands: Will estuarine tidal wetlands survive climate change? California Estuarine Research Society & Western Section-Society of Wetland Scientists Annual Meeting, March 2010, University of San Diego, San Diego, CA. *Invited Keynote Speaker*.

Stralberg, D., J. Wood, M. Fitzgibbon, D. Jongsomjit, S. Crooks, M. Brennan, L. Schile, J. Callaway, V.T. Parker. Spatial climate change scenarios for San Francisco Bay Tidal marsh habitats. September 2010, Bay-Delta Authority Science Conference, Sacramento, CA

Callaway, J., V.T. Parker, L. Schile, E. Herbert, E. Borgnis, L. Porcella. Sediment dynamics at the island ponds: indications from early salt pond restoration. September 2010, Bay-Delta Authority Science Conference, Sacramento, CA

Parker, V.T., J. Callaway, E. Herbert, L. Schile, V. Vredenburg, M. Vasey, E. Borgnis, M. Kelly, J. Van Den Berg. How climate change may impact San Francisco Bay Delta wetlands and their links to pelagic food webs. September 2010, Bay-Delta Authority Science Conference, Sacramento, CA

Schile, L., M. Vasey, V.T. Parker, J. Callaway, E. Herbert, N.M. Kelly. Tidal wetland vegetation diversity gradients across and within sites in the San Francisco Bay Estuary. September 2010, Bay-Delta Authority Science Conference, Sacramento, CA

Borgnis, E., V.T. Parker, J. Callaway, E. Herbert, L. Schile. Below-ground biomass dynamics across the San Francisco Bay-Delta: Organic and mineral matter contributions to tidal wetland accretion. September 2010, Bay-Delta Authority Science Conference, Sacramento, CA

2009

Parker, VT, J Callaway, E Herbert, L Schile, M Vasey, V Vredenberg, E Borgnis, M Kelley and D Talley. Modeling the impacts of climate change and reduced freshwater flows on San Francisco Bay-Delta wetlands and their dependant plant and animal communities. Poster. 1st Ecological Society of America's Millennium Conference. Athens, GA. November 2009.

Parker, VT, J Callaway, E Herbert, L Schile, M Vasey, V Vredenberg, E Borgnis, M Kelley, D Talley. Modeling the impacts of climate change on San Francisco Bay-Delta wetlands and links to pelagic food webs. *Poster*. Coastal and Estuarine Research Federation, Portland, Oregon, November 2009

Callaway. J. C.; V.T. Parker; J. Drexler; R. Turner; L. Schile; E. Herbert; E. Borgnis. Evaluating Sediment Accumulation Rates in San Francisco Bay Wetlands for Restoration, Sea-Level Rise, and Carbon Sequestration. Coastal and Estuarine Research Federation, Portland, Oregon, November 2009

Parker, VT, J Callaway, E Herbert, L. Schile, M Vasey, V Vredenberg, E Borgnis, M Kelly and D Talley. Modeling the impacts of climate change and reduced freshwater flows on the San Francisco Bay-Delta wetlands and their dependant plant and animal communities. *Poster*. 2009 State of the Estuary Meeting. Oakland, CA. October 2009.

Parker, VT, J Callaway, E Herbert, L Schile, M Vasey, V Vredenberg, E Borgnis, M Kelly and D Talley. Modeling the impacts of climate change on San Francisco Bay-Delta wetlands and links to pelagic food webs. *Poster*. 2009 Pacific Division of the American Association for the Advancement of Science Conference. San Francisco, CA.

Schile, L., J. Callaway, V. T. Parker, E. Herbert. Rapid sediment accumulation in a restoring tidal salt marsh in the South Bay Salt Pond Restoration Project. State of the Estuary, Oakland, CA, 29 September-1 October 2009.

Callaway, J.C. Bay wetland plants and sediments: Inseparable in the face of climate change. State of the Estuary, Oakland, CA, 29 September-1 October 2009.

Parker, V.T., J.C. Callaway, E.R. Herbert, L.M. Schile, V.T. Vredenburg, M.C. Vasey, E.L. Borgnis, N.M. Kelly, and D.M. Talley. Modeling the Impacts of Climate Change on San Francisco Bay-Delta Wetlands and Links to Pelagic Food Webs, Meeting of the American Association for the Advancement of Science, San Francisco, CA, August 2009

Parker, V.T., J.C. Callaway, E.R. Herbert, L.M. Schile, M.C. Vasey. Potential impacts of climate change on San Francisco Bay-Delta marsh vegetation. Society of Wetland Scientists (Annual Meeting), Madison, Wisconsin, 21-26 June 2009.

Callaway, J.C., V.T. Parker, J.Z.Drexler, R.E. Turner, L.M Schile, E.R. Herbert, E.L. Borgnis. Dynamics of sediment accumulation in San Francisco Bay wetlands. Society of Wetland Scientists (Annual Meeting), Madison, Wisconsin, 21-26 June 2009.

Parker, V.T., J.C. Callaway, M.C. Vasey, L.M. Schile, and E.R. Herbert. Climate change impacts on San Francisco Bay-Delta tidal wetlands. California Native Plant Society Conservation Conference, 17-19 January 2009; Sacramento, CA.

Dailey, B.A. and V.T. Parker. The effect of increased salinity due to rising sea levels on germination rates in the San Francisco Bay-Delta. California Native Plant Society Conservation Conference, 17-19 January 2009; Sacramento, CA.

2008

Parker, V.T., J.C. Callaway, L.M. Schile, E.R. Herbert, M.C. Vasey. Potential impacts of climate change on Bay-Delta marsh vegetation. CalFed Science Conference; 20-22 October 2008; Sacramento, CA.

Parker, V.T., J.C. Callaway, L.M. Schile, E.R. Herbert, D.M. Talley, V.T. Vandenburg, N.M. Kelly. Elimate change impacts to San Francisco Bay-Delta wetlands and their links to pelagic food webs. CalFed Science Conference; 20-22 October 2008; Sacramento, CA.

Vasey, M.C., J.C. Callaway, E.R. Herbert, V.T. Parker, L.M. Schile. Shifting composition of tidal marsh plant species along a salinity gradient in the San Francisco Bay-Delta CalFed Science Conference; 20-22 October 2008; Sacramento, CA.

Schile, L.M., R.R. Carson, J.C. Callaway, V.T. Parker, M.C. Vasey, S.Siegel. Elevation, Inundation, and Vegetation patterns in natural and restored tidal wetlands CalFed Science Conference; 20-22 October 2008; Sacramento, CA.

Dailey, B.A. and V.T. Parker. Effects of salinity on germination in a brackish-freshwater system in response to climate change. CalFed Science Conference; 20-22 October 2008; Sacramento, CA.

Callaway, J.C., V.T. Parker and L.M. Schile. Sediment dynamics at the newly restored Island Ponds, South San Francisco Bay. CalFed Science Conference; 20-22 October 2008; Sacramento, CA.

Callaway, J.C., V. T. Parker, M.C. Vasey, L.M. Schile, and E.R. Herbert. Climate Change Impacts on Tidal Wetland Vegetation. SERCAL; 15th Annual Conference, August 13-16, 2008.

Callaway, J.C. 2008. Plant colonization in restored tidal wetlands: Potential wind wave impacts. Workshop on Wind Waves and Tidal Wetlands Workshop. San Francisco Bay Conservation and Development Commission, 18 March 2008.

Parker, V.T. 2008. Climate change and the San Francisco Bay-Delta tidal wetlands. Interagency Ecological Program, 2008 Annual Workshop. Asilomar Conference Grounds, 27-29 February 2008.

Schile, L. M., J. C. Callaway, V. T. Parker, M. C. Vasey, et al. 2008. Elevation, inundation and vegetation patterns in the San Francisco Bay-Delta. 14-15 January 2008: Northern California Botanists meeting, Chico, CA. Invited speaker for the meeting.

Callaway, J.C. 2008. Restoring wetland ecosystems: The importance of plant diversity and sediment dynamics. UC Berkeley Conservation Biology Student Chapter, 29 January 2008.

2007

Parker, V. T., L. M. Schile, J. C. Callaway and M. C. Vasey. Fading to blue: effects of inundation and salinity on tidal marsh vegetation. 16-18 October 2007: State of the Estuary Meeting, Oakland CA. Invited speaker for one of the symposia.